There are five presentations in the sessions.

1.
Jeff Whitaker presented the Developments of 20CR using Ensemble Kalman filter. He showed that 20CR surface pressure only analysis is a useful testbed for new ideas. For this case without many observations, QC is very important. Non-Gaussian QC and varying localization length scales are novel aspects of the new development. They believe that, the QC technique, together with high-resolution model, should produce an analysis that is ~25% better than 20CRv2.

Q: What is the difference from Fuqing's (adaptive covariance relaxation?) method?
A: Similar but adding perturbation to the ensemble. Retain the rotation of the structure but change the amplitude.

2.
Jack Woollen showed comparison of two ensemble based reanalysis systems, the NCEP dual-res (T254/126 Hybrid 3D-VAR/EnKF, and ERSL single-resolution (NOSAT) pure EnKF, for three 1-year period, and their comparison with ERA/ERAInt and GR1. He concluded that the EN system shows good potential to rerun GR1 very efficiently. The EN results are good in the Northern hemisphere even without satellite observations, but direct radiance assimilation is necessary for a full GR1 replacement. The faster NOSAT could be used for reanalyzing 1948-1975.

Q: What is the ensemble single forecast?
A: Using the spread of the ensemble to make one single forecast.
Q: You showed a wind divergence in 1981. Could it be caused by volcanic aerosol?
Q: does GR1 replacement really need satellite data?
Q: do you have SH applications to show the need of observations?
Q: 1975 ensemble without radiance works better or even improved.
There were discussions on the meaningfulness of the ensemble-mean forecast.

3.
Daryl Kleist presented the progress on the 4D hybrid EnVar and other DA development for the NCEP GFS. He showed experiments with real observations using hybrid 3D-Var and hybrid 4D-VAR, bias correction for radiance and conventional obs, and assimilation of cloud/precipitation. He suggested a suite of future work to be conducted at NCEP/UMD, including scale-dependent scaling, synergy between ENVAR and ENKF, etc.

Q: Is hydrid 4DVAR work as real as 4DVAR?
Q: Have you done any head-to-head comparison?
A: with right configuration, experiments showed hybrid 4DVAR is not 100% 4DVAR but close.

4.

Eugenia Kalnay presented new applications of data assimilation to reanalysis, basically on correcting on model bias and reanalysis jumps. She showed estimate and correct model bias by focusing on the analysis increments She showed to find diurnal cycle model errors using EOFs from reanalysis. She showed to find the state dependent errors using coupled SVD's. She proposed a correction scheme that is based on new and old AI to correct potential bias introduced by new observations.

Q: How important is diurnal cycle error?
A: the correction will reduce the bias.
Q: ??
A: There are two parts in the correction. First, correction for jump , and Second, correction for model bias.

5.
Gil Compo presented reanalysis for Tambora 1815. He showed that 20CR surface pressure only reanalysis can do 1815 with good skills. He showed that the circulation change may be driven by aerosol. He showed that the reanalysis variability seems to be larger than the signals derived from tree rings.

Q: When you go back to that far, there are many rainfall observations that could be useful.
Q: The time series of the reanalysis skills show that the aerosol improvement is statistically significance.

Discussion

Three questions:
1. Can we prove (analytically or by cleverly designed numerical experiment) that we can produce (temporally) homogeneous analyses from an inhomogeneous data input, no matter how egregious the inhomogeneity of the latter?
2. What research approach(es) are required to understand reasons for jumps in climate reanalysis with new observational platforms?
3. In a "pure" Ensemble Kalman Filter, is the ensemble mean analysis meaningful?

On Question #3
Q: For a single forecast based on the ensemble mean forecast, the ensemble mean is not balanced.
A: For initial assessment, ensemble mean is the first thing to look at and easy to access.
Q: How unbalanced can the ensemble-mean be?
A: Analysis is about fit to data. Can a pure ensemble system be balanced?
A: If there is any imbalance, it should show up in precipitation.
A: forecast system is always unbalanced.
A: ensemble-mean doesn't mean anything.

On Question #2,
Q: how can we know where the jumps come from, where is the model bias, and how do we diagnose that?
Q: there are model drifts in addition to jumps. Jumps are technically can be corrected, while drifts are usually not seen.
A: Drifts are also a concern, can be a confluence of model biases and jumps.
A: there are no automatic ways to identify them.
A: Need feedback data. Some gridded versions of intercomparisons.
A: Get it into community and go to common format.